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# Physical Measurements on CHICKEN FEATHERS*

## *I. Compression Tests*

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CHICKEN feathers, an agricultural by-product, are potentially an important raw material. At intervals they have been a waste product that totaled approximately 100,000,000 pounds per year (7). In order to utilize chicken feathers more effectively, it is necessary that more be known about their properties. One practical method of approach to the problem of utilization is through studies on the physical properties of feathers in their definitive form. Uses of feathers as such depend primarily upon certain of their physical properties.

The specific purpose of this portion of the investigation was to obtain data on the recovery of chicken feathers after compression. Compression-recovery data were used to calculate per cent recovery, one indication of performance of feathers in actual use. Recovery from a distorting force is not all of one kind. That which occurs instantaneously is known as elastic recovery or elasticity; that which occurs over a period of time is creep recovery, or a delayed recovery; that which does not occur is permanent deformation or permanent set.

In general, the range is small over which fibrous materials possess perfect elasticity. On the other hand, such materials like other plastic substances, undergo considerable creep recovery after a load is removed which has been allowed to remain for some time or which has been repeatedly applied. The creep recovery or delayed elasticity is the time factor (3) necessary to explain much of the complex mechanical behavior of large molecules. Creep recovery is considered to take place as molecules shift slowly back to positions of less strain after the load is removed. However, if molecular structures are so disarranged that the material does not recover its original form, permanent deformation is considered to have occurred. Deformation and recovery of molecular structures are affected by such factors as time, humidity, temperature, size of load and in certain instances by the previous history of the material.

Creep is of two kinds, primary and secondary. Both occur during distortion and recovery. The creep which occurs during distortion and results in recovery is primary creep or delayed elasticity. That which occurs during distortion and does not result in recovery is secondary creep or permanent deformation. Repeated distortion increases secondary creep by increasing the disarrangement of molecules and producing an increasing amount of strain in molecular structures. Creep and creep recovery according to Leaderman (2) are of much greater significance in the behavior of filamentous materials than in the behavior of a more rigid material. Except for such work as that of Weber (2) on silk and that of Speakman on wool (8), one of the more significant studies on the behavior of filamentous materials under a distorting force is that of Leaderman (2) who studied the behavior of various high polymers under a longitudinal load for varying lengths of time. According to Leaderman, "the artistic and profitable utilization of fibrous materials must depend more and more on the knowledge of their stress-strain - time - temperature - humidity behavior." Leaderman prefaced his studies by an excellent review of the works of Weber, R. and F. Kohlrausch, Beltzman, Hopkins, Klemencic and Bennewitz, all of whom contributed to an understanding of the fundamental principles underlying creep and creep recovery of materials.

## EXPERIMENTAL

### *Compression Apparatus*

A simple type of mechanical test, the load deformation test, is used to study creep. The load may act to extend, to twist, to flex or to compress the material (1). However, except for isolated studies in pile fabrics (6), rayon flock (5), wool fibers (9) and upholstery stuffing (9), compression tests have not been generally made on materials of the type used in this study.

It was decided that a simple mechanism (Fig. 1) could be devised which would be sensitive and yet simple to operate. The apparatus, sensitive to 0.4 gram, consisted of a basket (Fig. 1, Diagram "B") suspended on a pulley. The basket was made of a wire gauze to permit a free circulation of air during the compression.

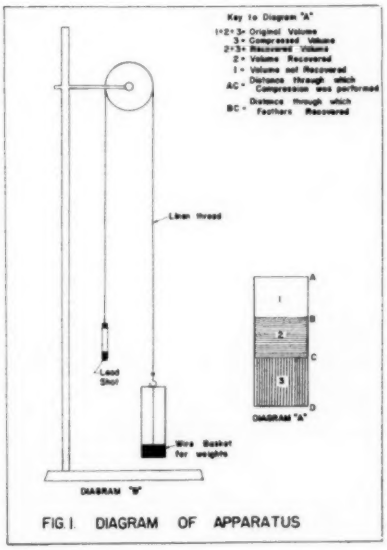


FIG. 1. DIAGRAM OF APPARATUS

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This precaution was taken in order to keep at a minimum any effect that air pressure might have on the compression measurement. A counterbalanced basket was designed to carry the weights. Feathers were placed in cylinders 15 cm. high (Fig. 1, Diagram "A").

The use of different cylinders came about in this way. A cylinder of 4.4 cm. diameter was obtained to begin the tests. It was later observed that feathers longer than 4.4 cm. dragged on the walls of the cylinder and gave erratic results. Therefore a cylinder of 5.7 cm. was obtained. It was then found that, for the smaller samples of cut barbs, more uniform results were obtained if a smaller cylinder was used. The smaller cylinder gave a greater depth in proportion to diameter for compression.

The dimensions of the cylinders and the corresponding baskets were as follows:

### *Cylinders*

| *Height (cm.)* | *Diameter (cm.)* | *Cross section area ($cm.^2$)* | *Volume (ml.)* |
|---|---|---|---|
| 15.0 | 5.7 | 25.5 | 382.0 |
| 15.0 | 4.0 | 12.6 | 188.5 |
| 15.0 | 2.8 | 7.8 | 92.4 |

### *Baskets*

| *Diameter (cm.)* | *Cross section area ($cm.^2$)* |
|---|---|
| 5.5 | 23.8 |
| 3.8 | 11.3 |
| 2.6 | 5.5 |

The compression tests were made with the following gram weights in the order of increasing weights in each run of

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0.4 | 1.0 | 1.6 | 2.5 | 4.0 | 7.0 | 13.0 | 25.0 | 40.0 |
| 0.6 | 1.2 | 1.8 | 3.0 | 4.5 | 9.0 | 15.0 | 30.0 | 45.0 |
| 0.8 | 1.4 | 2.0 | 3.5 | 5.0 | 11.0 | 20.0 | 35.0 | 50.0 |

### *Preparation of Feathers*

Chicken feathers were prepared in different ways to determine the effect of their form on recovery from compression. The results were compared with the results of similar tests on commercial samples of duck down and goose down. The following types of White Leghorn hen feathers were used: downy contour feathers, cut barbs, and stripped barbs. Commercial samples of goose down and duck down were used only for purposes of comparison. The chicken feathers came from mature hens of the Iowa State College poultry farm flock.

The feathers were washed twice with a 0.1 per cent solution of a soapless detergent and rinsed five or more times in distilled water. The wet feathers were spread thinly on plain paper to air dry. This method of cleaning and drying produced very fluffy feathers. Attempts at drying with commercial laundry equipment had produced unsatisfactory results.

The dry feathers were sorted as to type. The flight feathers, the pennaceous or ordinary contour feathers, and the plumose or downy contour feathers were the three big classes. Only downy contour feathers were used. These were sorted as to length. They ranged from less than one to 9 cm. in length. Only the 3.0 to 6.9 cm. lengths were used as whole feathers. The 2.0 to 9.9 cm. feathers were used for obtaining both the stripped barbs and the cut barbs. The stripped barbs used in these tests were obtained by hand pulling the barbs, the downy portion of the feathers, from the shafts of downy contour feathers. This procedure removed a small portion of the outer covering of the shaft, which held the barbs together and thus produced considerable curl in the material without introducing a great deal of stiffness. No attempt was made to keep separate the barbs stripped from the various lengths of feathers. The cut barbs were prepared by cutting the barbs from the shafts of the downy contour feathers. The cut barbs from the different lengths of feathers were kept separate and tested to determine the effect of length on recovery. The longer feathers had a greater proportion of longer barbs, thus producing a fluffier mass of material.

The number of samples tested for each feather specimen used is given below.

| *Specimen* | *No. of samples* |
|---|---|
| Chicken feathers | |
| downy contour | |
| 3.0-3.9 cm. (called 3 cm.) ..... | 1 |
| 4.0-4.9 cm. (called 4 cm.) ..... | 1 |
| 5.0-5.9 cm. (called 5 cm.) ..... | 1 |
| 6.0-6.9 cm. (called 6 cm.) ..... | 1 |
| cut barbs | |
| 2.0-3.9 cm. ..... | 3 |
| 4.0-6.9 cm. ..... | 5 |
| 7.0-9.9 cm. ..... | 3 |
| stripped barbs ..... | 3 |
| Goose down ..... | 2 |
| Duck down ..... | 2 |

All materials were loosely arranged, during rest intervals, in flat, open containers in order to secure maximum volume before each series of tests was performed.

### *Procedure*

The feathers were exposed in flat containers at 77° ±2° F. and 63 ±7 per cent relative humiidty for at least ten days before any tests were made. They remained at this temperature and humidity throughout all measurements. There were 23 samples of down and feathers. The downy contour feathers were refluffed before each test by being allowed to fall from tweezers into the cylinder. The cut barbs, the stripped barbs, the goose down, and the duck down were refluffed by a thin rod without removing them from the cylinder.

After the feathers were refluffed, a weight was placed in the basket, which was then brought to the top edge of the cylinder (Fig. 1, Diagram "A") and allowed to fall on the feathers. As soon as the basket came to rest, the volume was read and recorded as *compressed volume*. The volume of the feathers at the point of instantaneous recovery was recorded as *recovered volume*. The volume through which the feathers recovered was called *volume recovered*. These volumes were used in the calculation of per cent recovery.

In order to describe the organization of the tests, the following terminology was used:

*Test.* A test consisted of a single compression-recovery cycle on a weighed sample of feathers.

*Run.* A run was composed of a consecutive series of 27 tests using increasing weights from 0.4 to 50.0 grams.

*Series.* A series was a group of three consecutive runs. All were made on one day, and consisted of 81 consecutive tests on a single sample.

*Determination.* A determination was composed of the five series of runs made at the designated intervals on a single sample; 420 tests were made in one determination. One determination was made on each of 23 feather samples from the 10 specimens.

*Interval.* An interval was the period of time for rest between series and varied from 24 hours to 672 hours during the course of one determination (Figs. 6 and 7).

Per cent recovery was calculated by the following formula:

$$\% \text{ recovery} = \frac{bc}{ac} \times 100$$

The distances through which the feathers were compressed and through which they recovered were not constant. The distance "ac," or centimeters of compression, was obtained by subtracting the compressed height of the feathers (Fig. 1) from the original height; the distance "bc," or centimeters of recovery, was obtained by subtracting the compressed height from the recovered height.

The ratio of weight to volume (Table 7) was determined by dividing the average weight of the samples by the average volume of the samples. The cut barbs were weighed before and after running the compression tests and an average weight recorded because of loss of material during the tests. Air currents carried off some of the barbs. The weights used on the other samples were those taken after testing. No loss occurred during the compression testing of these samples.

## RESULTS AND DISCUSSION

### *Recovery*

Recovery data formed the basis for comparisons of: (a) downy contour feathers by length (Table 2, Fig. 3), (b) cut barbs by length (Table 3, Fig. 4), and (c) the three forms of chicken feathers with goose down and duck down (Table 4, Fig. 5).

In a run, as increasing pressure was used, the feathers were compressed through an increasing distance (Table 1, Fig. 2). After a certain point was reached there was a much smaller change in the amount of compression with increased ap-



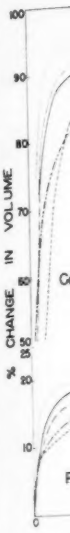


FIG. 2

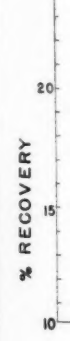


FIG. 3

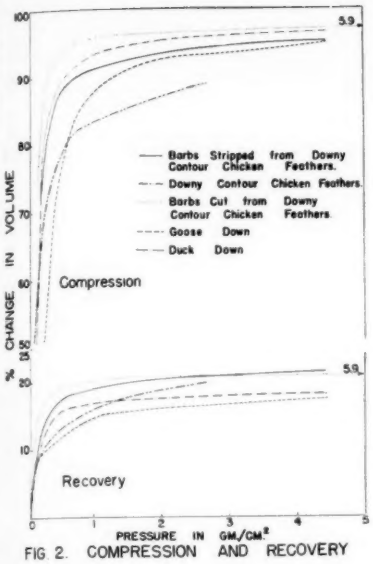


FIG. 2. COMPRESSION AND RECOVERY

*TABLE 1*
*Compression and Recovery of Down and Feathers*
*(in per cent)*

| Pressure gm./cm.² | Stripped Barbs | | Cut Barbs | | Downy Contour Feathers | | Goose Down | | Duck Down | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Comp. | Rec. | Comp. | Rec. | Comp. | Rec. | Comp. | Rec. | Comp. | Rec. |
| .06 | 38.3 | 5.1 | ... | ... | ... | ... | ... | ... | ... | ... |
| .09 | ... | ... | ... | ... | 48.2 | 7.2 | 18.2 | 7.0 | 32.6 | 7.8 |
| .11 | 54.5 | 7.9 | ... | ... | ... | ... | ... | ... | ... | ... |
| .12 | ... | ... | 75.4 | 14.5 | ... | ... | ... | ... | ... | ... |
| .16 | 61.3 | 8.9 | ... | ... | ... | ... | ... | ... | ... | ... |
| .18 | ... | ... | ... | ... | 71.4 | 12.0 | 37.6 | 9.3 | 68.9 | 10.5 |
| .24 | ... | ... | 87.8 | 17.2 | ... | ... | ... | ... | ... | ... |
| .26 | ... | ... | ... | ... | 79.2 | 13.9 | 53.4 | 9.9 | 78.4 | 12.3 |
| .27 | 70.1 | 11.0 | ... | ... | ... | ... | ... | ... | ... | ... |
| .35 | ... | ... | 91.2 | 18.0 | ... | ... | ... | ... | ... | ... |
| .44 | ... | ... | ... | ... | 86.9 | 17.1 | 72.6 | 11.4 | 88.5 | 15.2 |
| .59 | ... | ... | 94.2 | 19.6 | ... | ... | ... | ... | ... | ... |
| .70 | 80.2 | 14.3 | ... | ... | ... | ... | ... | ... | ... | ... |
| 1.15 | ... | ... | ... | ... | 91.4 | 19.3 | 89.0 | 15.0 | 93.8 | 17.0 |
| 1.54 | ... | ... | 96.2 | 20.7 | ... | ... | ... | ... | ... | ... |
| 1.61 | 85.7 | 17.9 | ... | ... | ... | ... | ... | ... | ... | ... |
| 2.65 | ... | ... | ... | ... | 94.2 | 20.6 | 93.2 | 16.2 | 95.6 | 17.9 |
| 2.68 | 88.9 | 19.7 | ... | ... | ... | ... | ... | ... | ... | ... |
| 3.56 | ... | ... | 97.0 | 20.9 | ... | ... | ... | ... | ... | ... |
| 4.40 | ... | ... | ... | ... | 95.2 | 21.4 | 95.0 | 17.4 | 96.6 | 18.1 |
| 5.91 | ... | ... | 97.6 | 20.7 | ... | ... | ... | ... | ... | ... |

plication of pressure. The per cent of recovery gradually increased (Table 1, Fig. 2) with increased pressure. The weights used for all tests were constant, but because cylinders of three diameters were used, the pressures applied in a given test varied for the different samples. The comparisons are valid, however, because the per cents of compression and recovery are ploted against pressure and not against weight (Fig. 2). There is not a constant relationship between the compressibiilty of the specimen and the per cent recovery. The cut barbs were the most compressible and exhibited the greatest degree of recovery. The downy contour feathers were the least compressible with the pressures used. They exhibited a recovery at a pressure of 2.5 gm./cm.,² which was close to that of the cut barbs and the stripped barbs. The goose down, duck down, and stripped barbs were very similar in their compressibility, but the goose down and duck down lacked the ability to recover from the pressures used as much as the stripped barbs. It was noted that the compression of goose down and duck down was accompanied by a matting of the barbs which hindered recovery. The per cent compression from maximum volume of the specimens increased very rapidly with pressures of under one gm./cm.²; above this pressure the change in volume with pressure was gradual.

The initial lack of recovery (Figs. 3 to 5) indicated that during the first four tests on chicken feathers, the first nine on duck down, and the first fifteen on goose down the feathers themselves were not deformed to any great extent. It is thought that at the lower pressures there was sufficient air space for the feathers to be pushed down without distorting them. After a certain amount of pressure was applied, the feathers themselves were deformed. The rachis or shaft offered more resistance than the barbs. The relationship between the compressed volume and the recovered volume is recovery. Recovery of the feathers began to approach a constant value by the 27th test (Fig. 5). The exception to this general behavior was the downy contour feathers, which were not tested under as much pressure as the other samples, because the cylinder used for these feathers had the largest diameter. The weights were constant, and therefore the weight per unit area was less. The behavior of the recovery curves (Figs. 3, 4, and 5) could be predicted from Fig. 2, after the per cent compression and the per cent recovery reached the point at which the change in volume with increased pressure was small. During the compression testing of feathers no point was found where the feathers possessed perfect elasticity, that is, perfect recovery after deformation.

*Recovery of downy contour feathers by length.* In Fig. 3 each value plotted represents an average value obtained from fifteen tests made at a given pressure during the determination. On the whole, with increased pressure there was a steady increase in the per cent of recovery of the

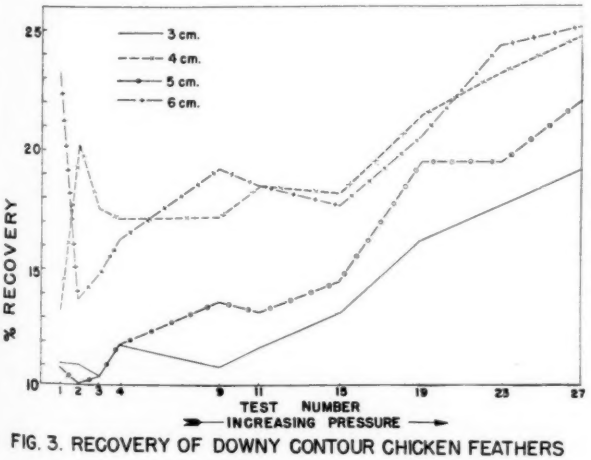


FIG. 3. RECOVERY OF DOWNY CONTOUR CHICKEN FEATHERS

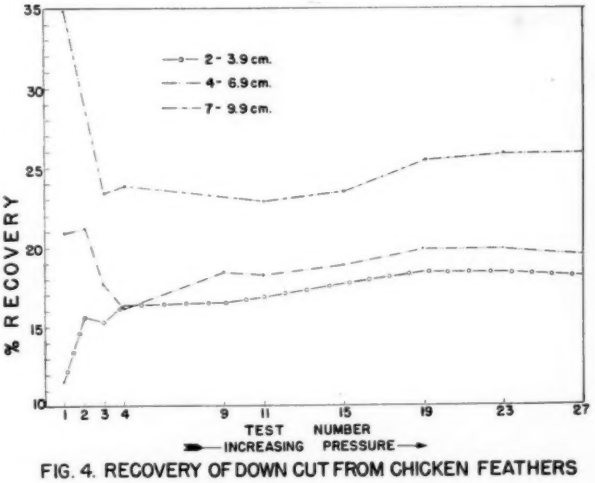


FIG. 4. RECOVERY OF DOWN CUT FROM CHICKEN FEATHERS

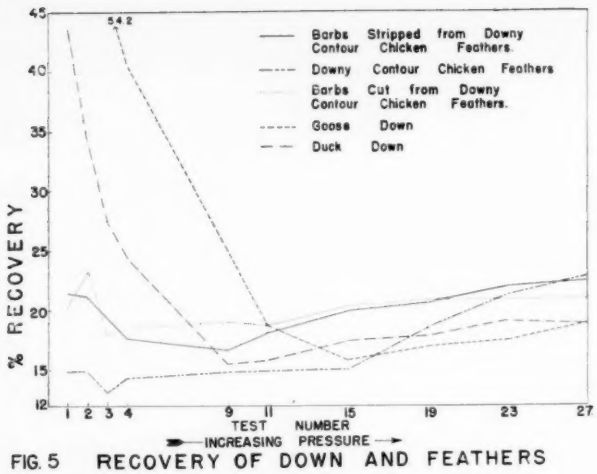


FIG. 5 RECOVERY OF DOWN AND FEATHERS

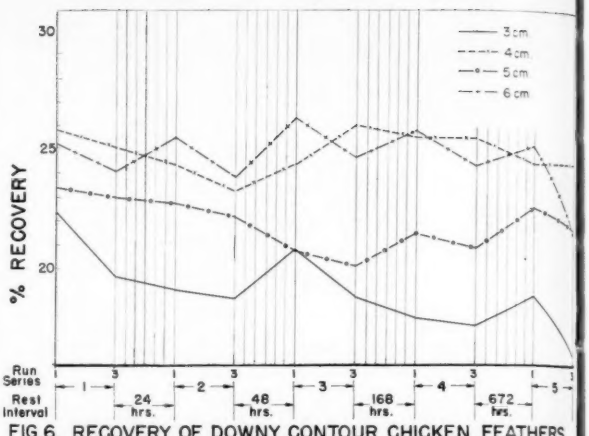


FIG. 6. RECOVERY OF DOWNY CONTOUR CHICKEN FEATHERS AS AFFECTED BY INTERVALS OF COMPRESSION AND REST
Values from the 27th test were used

various lengths of downy contour feathers (Table 2, Fig. 3). Complete data were collected for all twenty-seven tests, but only the ten test numbers listed in Table 2 were selected for analysis and comparison. Examination of the data indicated these values to be representative of all. The fact that the recovery of the 4 and 6 cm. feathers followed courses of such similar nature may have been the result of the particular sample chosen for each determination. The 3 cm. feathers exhibited a greater amount of recovery, and the 6 cm. feathers the most recovery except for certain tests in which the 4 cm. feathers had the highest recovery. The position of the curves for the 4 and 5 cm. feathers are unexpectedly interchanged. The longer feathers had a greater proportion of quill to barbs and therefore, within certain limits, should show a higher per cent recovery.

*TABLE 2*
*Per Cent Recovery of Downy Contour Chicken Feathers*

| Test No. | Feather Length 3 cm. | 4 cm. | 5 cm. | 6 cm. |
|---|---|---|---|---|
| 1 | 11.1 | 13.2 | 10.9 | 23.2 |
| 2 | 11.0 | 20.2 | 10.3 | 13.8 |
| 3 | 10.6 | 17.6 | 10.6 | 14.8 |
| 4 | 11.9 | 17.2 | 11.9 | 16.3 |
| 9 | 11.0 | 17.2 | 13.7 | 19.2 |
| 11 | 11.8 | 18.2 | 13.3 | 18.6 |
| 15 | 13.2 | 18.3 | 14.6 | 17.8 |
| 19 | 16.3 | 21.4 | 19.6 | 20.6 |
| 23 | 17.7 | 23.3 | 19.6 | 24.4 |
| 27 | 19.2 | 24.8 | 22.1 | 25.2 |

Similar tests on rayon flock (5) showed an increase of per cent recovery with an increase in the denier of the fiber. In other words, the ratio of length to thickness affects the compression-recovery behavior of this type of material.

The recovery increased steadily with increased loads irrespective of the length of the feather. Whether recovery would continue to increase with great increase of weight is doubtful, since compression at high pressures would fracture the feather structure and thus reduce the abiilty to recover.

*Recovery of cut barbs by length.* In Fig. 4 each value plotted represented an average of three to five determinations. Each determination was composed of fifteen compression-recovery cycles. After the fourth test the amount of recovery of cut barbs gradually increased through the nineteenth test. There was little further increase in recovery and the beginning of decline was evident in the two shorter groups of barbs (Table 3).

*TABLE 3*
*Per Cent Recovery of Barbs Cut from Downy Contour Chicken Feathers*

| Test No. | Feather Length 2-3.9 cm. | 4-6.9 cm. | 7-9.9 cm. |
|---|---|---|---|
| 1 | 11.5 | 20.8 | 34.9 |
| 2 | 15.6 | 21.2 | 28.9 |
| 3 | 15.3 | 17.7 | 23.4 |
| 4 | 16.3 | 16.2 | 23.8 |
| 9 | 16.5 | 18.4 | 23.1 |
| 11 | 16.8 | 18.4 | 22.8 |
| 15 | 17.7 | 18.8 | 23.5 |
| 19 | 18.4 | 19.8 | 25.4 |
| 23 | 18.3 | 19.8 | 25.8 |
| 27 | 18.1 | 19.5 | 25.9 |

Actual deformation of the feathers was slight until after the fourth test for all the samples of cut barbs. The barbs from the 7.0 to 9.9 cm. feathers actually showed no increase in recovery until after the fifteenth test. A similar behavior was observed in goose down (Fig. 5). From the fourth to the twenty-seventh test, the per cent recovery of the barbs increased for all samples as is indicated in the tabulation below.

| Length of Feathers (cm.) | % Increase in Recovery |
|---|---|
| 2-3.9 | 1.8 |
| 4-6.9 | 3.3 |
| 7-9.9 | 2.1 |

The shape of the curve seemed to show no relationship to the length of feathers from which the barbs were cut. There was a relationship between the length of the feathers from which the barbs were cut and the amount of recovery. The barbs cut from the longest feathers showed the greatest recovery, and the barbs cut from the shortest feathers showed the least. The barbs from the longer feathers in general had larger dimensions; therefore the results may be compared to those with rayon flock and wool. The coarser material was less compressible and showed greater recovery.

*Recovery of down and feathers.* Each value (Table 4) plotted in Fig. 5 represented an average of 30 to 180 tests taken during two to twelve determinations.

*TABLE 4*
*Per Cent Recovery of Down and Feathers*

| Test N | Chicken Feathers Downy Contour Feathers | Stripped Barbs | Cut Barbs | Goose Down | Duck Down |
|---|---|---|---|---|---|
| 1 | 14.9 | 21.4 | 20.3 | 54.2 | 43.8 |
| 2 | 14.8 | 21.1 | 23.3 | 51.1 | 34.6 |
| 3 | 13.2 | 19.4 | 18.0 | 59.3 | 27.4 |
| 4 | 14.3 | 17.7 | 18.5 | 40.6 | 24.8 |
| 9 | 14.9 | 16.7 | 19.1 | 25.1 | 15.6 |
| 11 | 14.9 | 18.1 | 18.9 | 18.8 | 15.8 |
| 15 | 15.1 | 20.0 | 20.4 | 15.9 | 17.4 |
| 19 | 18.7 | 20.7 | 21.0 | 17.0 | 17.5 |
| 23 | 21.3 | 22.0 | 21.1 | 17.6 | 19.3 |
| 27 | 23.0 | 22.6 | 21.0 | 19.0 | 19.0 |

The variations in the number of tests used for these average values is a result of the number of duplicates of samples tested in the course of the study. Twelve samples from eight specimens of cut barbs were tested to determine the effect of the length of the feathers on the recovery of the barbs. To determine the per cent recovery of cut barbs, irrespective of length, values obtained from the twelve samples were averaged. These were three samples of stripped barbs and two each of goose down and duck down. Duplicates were used wherever possible in order to eliminate some of the variations in samples and some of the experimental error. In Fig. 5 it can be observed that for goose down and duck down very much greater

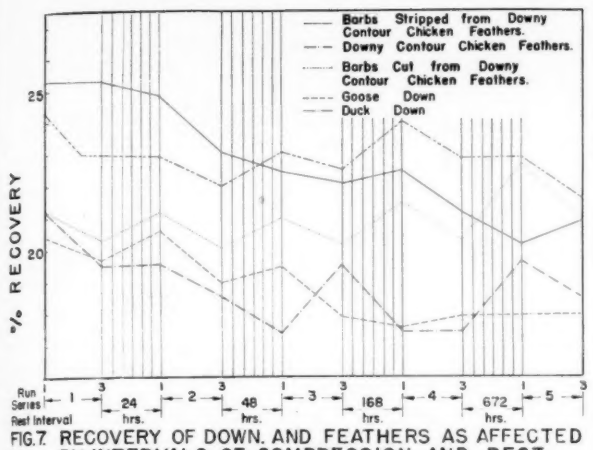


FIG. 7. RECOVERY OF DOWN AND FEATHERS AS AFFECTED BY INTERVALS OF COMPRESSION AND REST

Values from the 27th test were used

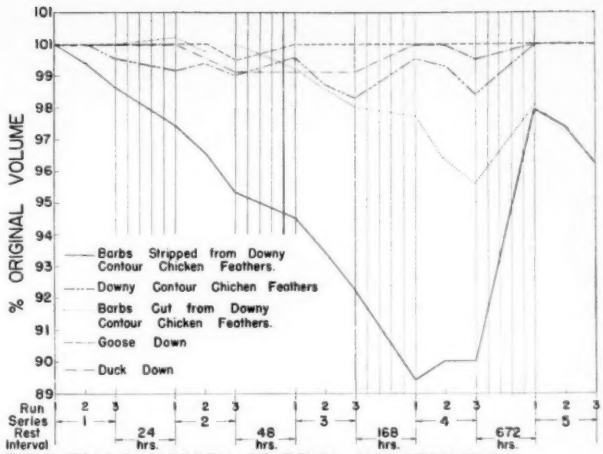


FIG. 8. FILLING CAPACITY OF DOWN AND FEATHERS

Before first test in each run

pressures are required to compress the material to the point where it begins to behave as a resilient material than are required for the chicken feathers. Part of this is probably caused by the manner in which the down or feathers pack or mat together. From the fifteenth to the twenty-seventh test the recovery of the downy contour feathers increased the most. With increased pressure the work done by the sample on recovery increased more rapidly than did the work done on the sample as indicated by distances recovered and compressed. The slope of the line representing the cut barbs indicated that the work done by the barbs on recovery increased very little with increased amounts of work done on them during compression. Of all the materials, the cut barbs showed the greatest tendency to mat. The stripped barbs came second only to the downy contour feathers in retaining their springiness, as indicated by the per cent recovery. The goose down and duck down clung together in spongy masses after compression, and consequently showed a low per cent recovery.

### *Permanent Deformation*

Permanent deformation is the result of creep occurring in the material as a result of a load. Filamentous materials are especially susceptible to creep which may result from either a constant load or a repeated load and may lead to permanent deformation. If the deformation is the result of primary creep, the molecules will be able to recover their former position. If the deformation is the result of secondary creep, the molecules have become so far removed from their original position that they are unable to return to their normal positions and a permanent strain develops. If the secondary creep is allowed to continue, eventually the strain will be so great that the material will fracture.

The effect of creep was noticed in the limp appearance of feathers after repeated compression, in variations in their filling capacity (Fig. 8), and in variations in the per cent recovery from run to run and series to series within a determination. (Tables 5 and 6, Figs. 6 and 7.)

*Permanent deformation of downy contour feathers of* different lengths. Each value in Table 5 and Fig. 6 is an average of the values obtained from the twenty-seventh test of three runs on a given specimen. Except for the 3 cm. downy contour feathers there was very little permanent deformation during a determination (Fig. 6). The 3 cm. feathers declined steadily in ability to recover.

### *TABLE 5*

### *Permanent Deformation of Downy Contour Chicken Feathers as Measured by Changes in Per Cent*

| | | *Feather Length* | | | |
|---|---|---|---|---|---|
| *Series* | *Run* | *3 cm.* | *4 cm.* | *5 cm.* | *6 cm.* |
| 1 | 1 | 22.4 | 25.8 | 23.4 | 25.3 |
| | 3 | 19.7 | 25.1 | 23.0 | 24.1 |
| 2 | 1 | 19.2 | 24.4 | 22.8 | 25.6 |
| | 3 | 18.7 | 23.3 | 22.1 | 23.9 |
| 3 | 1 | 10.9 | 24.4 | 20.8 | 26.4 |
| | 3 | 18.9 | 26.1 | 20.2 | 24.8 |
| 4 | 1 | 18.1 | 25.6 | 21.6 | 25.8 |
| | 3 | 17.7 | 25.6 | 21.0 | 24.4 |
| 5 | 1 | 19.0 | 24.6 | 22.7 | 25.3 |
| | 3 | 16.6 | 24.6 | 21.8 | 21.7 |
| Total change | | —5.8 | —1.2 | —1.6 | —3.6 |

The 5 cm. feathers present a mixture that is most nearly like one that would be expected. There was no recovery until after the 168-hour rest when the feathers recovered 1.4 per cent. After this recovery there was a decrease in per cent recovery from the first to the third run of series 4 and after the 672-hour rest a recovery of 1.7 per cent. In making comparisons of per cent recovery from the first test of the first run of the first series to the first test of the first run of the last series, which was performed after a rest of 672 hours, the per cent recovery was found to change as follows:

| *Length of Feather* | *Per Cent Loss in Recovery* |
|---|---|
| 3 cm. | 3.4 |
| 4 cm. | 1.2 |
| 5 cm. | 0.7 |
| 6 cm. | 0.0 |

*Permanent deformation of down and feathers.* Each value in Table 6 and Fig. 7 is an average of from two to twelve tests. The exact number of tests in each case depended upon the number of available samples.

Except for the cut barbs, none of the samples regained completely their original volume even after a rest of 672 hours (Fig. 7). The cut barbs showed a greater per cent recovery after the rest of 672 hours than they did in the beginning. Because of sample losses from air currents during the determination this increased per cent recovery is probably not significant. In the first two series of tests, the stripped barbs exhibited the greatest recovery, but lost the most during the determination. However, even at the end of the determination the recovery was greater than that of the goose down and duck down. Only further testing would determine the commercial value of the stripped barbs. Its commercial use would depend in part on whether or not the per cent recovery remained comparatively high or continued to decline on repeated deformation. It should be stated here that the tests made in this study are not considered to have measured the useful life of these feathers.

In the following tabulation, values are given to indicate the change in recovery from the first test of the first run of the first series to the first test of the first run of the last series of a determination.

| *Material* | *% Change in Recovery* |
|---|---|
| Cut barbs | +1.5 |
| Duck down | —1.5 |
| Down contour feathers | —1.5 |
| Goose down | —2.5 |
| Stripped barbs | —5.1 |

### TABLE 6
*Per Cent Recovery as a Measure of Permanent Deformation of Down and Feathers*

| Series | Run | Chicken Feathers: Downy Contour Feathers | Chicken Feathers: Stripped Barbs | Chicken Feathers: Cut Barbs | Goose Down | Duck Down |
|---|---|---|---|---|---|---|
| 1 | 1 | 24.3 | 25.3 | 21.3 | 20.4 | 21.2 |
| | 3 | 23.0 | 25.3 | 20.3 | 19.7 | 19.5 |
| 2 | 1 | 22.9 | 24.8 | 21.2 | 20.6 | 19.6 |
| | 3 | 22.0 | 23.1 | 20.1 | 19.0 | 18.6 |
| 3 | 1 | 23.1 | 22.4 | 21.0 | 19.5 | 17.4 |
| | 3 | 22.6 | 22.1 | 20.2 | 17.9 | 19.6 |
| 4 | 1 | 24.1 | 22.4 | 21.5 | 17.6 | 17.4 |
| | 3 | 22.8 | 21.2 | 20.3 | 17.9 | 17.4 |
| 5 | 1 | 22.8 | 20.2 | 22.8 | 17.9 | 19.7 |
| | 3 | 21.6 | 20.9 | 21.0 | 17.9 | 18.4 |
| Total change | | —2.7 | —4.4 | —.3 | —2.5 | —2.8 |

The loss in recovery after a rest of 672 hours may be considered a relative indication of the permanent deformation from which the feathers and down are not likely to recover.

*Filling Capacity*

Filling capacity is a measure of the fluffiness of the material. The more a given material can be fluffed the greater the volume filled by an equal weight of that material and the lighter will be the finished product. The filling capacity of feathers is important in their industrial utilization. Below (Table 7) are given the ratios of weight to original volume.

### TABLE 7
*Weight/Volume Ratios of Down and Feathers*

| Material | Weight (micrograms) | Volume (ml.) | Wt./Vol. |
|---|---|---|---|
| Duck down ..... | 202 | 377 | .54 |
| Goose down ..... | 313 | 377 | .83 |
| Cut barbs ..... | 1,282 | 1,547 | .83 |
| Stripped barbs .. | 659 | 377 | 1.75 |
| Downy contour feathers ..... | 4,397 | 1,334 | 3.25 |

Changes in filling capacity occur after repeated compressions (Fig. 8, Table 8). The remaining loss in volume after the 672-hour rest was used as the measure of permanent deformation. After repeated compression the feathers do not recover to their original volume, aided or unaided, until after a period of rest. Accompanying this loss in filling capacity is a change in the appearance of the feathers as a result of repeated compressions. The stripped barbs become limp and cling together. The downy contour feathers also become limp. The barbs and barbules tend to cling to each other and to the shaft rather than to stand erect. The shaft, however, seemed to retain its stiffness. Both the duck down and the goose down formed a spongy mass that was difficult to fluff because of interlocked barbs. The variations in initial filling capacity are tabulated in Table 8. These values were obtained after the feathers had been fluffed and before the first test in each run of the determination. The values for downy contour feathers in series two and five are averages of three rather than four samples. At this point the humidity became too high during the testing, and the values obtained were very low and were, therefore, discarded.

### TABLE 8
*Filling Capacity of Down and Feathers*

| | | Per Cent of Original Volume | | | | |
|---|---|---|---|---|---|---|
| | | Chicken Feathers | | | | |
| Series | Run | Downy Contour Feathers | Stripped Barbs | Cut Barbs | Goose Down | Duck Down |
| 1 | 1 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| | 2 | 100.0 | 99.4 | 100.0 | 100.0 | 100.0 |
| | 3 | 99.6 | 98.5 | 100.0 | 100.0 | 100.0 |
| 2 | 1 | 98.3 | 97.4 | 100.2 | 100.0 | 100.0 |
| | 2 | 98.5 | 96.5 | 99.8 | 100.0 | 99.8 |
| | 3 | 97.6 | 95.4 | 100.0 | 99.6 | 99.1 |
| 3 | 1 | 99.6 | 94.5 | 99.2 | 100.0 | 99.1 |
| | 2 | 98.7 | 93.4 | 98.6 | 100.0 | 99.1 |
| | 3 | 98.3 | 92.8 | 98.0 | 100.0 | 99.1 |
| 4 | 1 | 99.6 | 89.4 | 97.8 | 100.0 | 100.0 |
| | 2 | 99.3 | 90.0 | 96.5 | 100.0 | 100.0 |
| | 3 | 98.5 | 90.0 | 95.6 | 100.0 | 99.6 |
| 5 | 1 | 100.0 | 98.0 | 98.1 | 100.0 | 100.0 |
| | 2 | 100.0 | 97.4 | 97.2 | 100.0 | 100.0 |
| | 3 | 100.0 | 96.2 | 96.4 | 100.0 | 100.0 |

Chicken feathers, in general, increased in compressibility and in per cent instantaneous recovery with a decrease in particle size of the material. The tendency of the barbs of the goose down and duck down to mat or felt seemed to be the cause of their resistance to compression and recovery.

The loss in per cent recovery of down and feathers was small over the range of pressures used except in the case of the stripped barbs. The recovery of feathers and cut barbs increased with length and increased with pressure within the limits of the pressures used in this study. The downy contour feathers, in general, showed the most recovery, and the cut barbs the least. Goose down and duck down were low in per cent recovery because of their tendency to mat or felt.

Permanent deformation, as measured by the loss of recovery, increased as feathers got shorter and was most evident in the stripped barbs, which showed a loss in per cent recovery and a loss of filling capacity. Both the goose down and the duck down exhibited high filling capacity after compression, and therefore showed little or no measurable permanent deformation.

The weight of feathers per unit volume was found to increase in the following order: duck down, goose down, cut barbs, stripped barbs, and downy contour feathers.

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## SUMMARY

The data for this study were obtained from compression-recovery tests on ten feather specimens composed of twenty-three samples. Tests were performed at stated periods with alternating intervals of rest. Compression, recovery, permanent deformation, filling capacity, and weight per unit volume of downy contour feathers by length, cut barbs by length, stripped barbs, duck down, and goose down were determined.

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# THE ANALYSIS OF GREASE WOOL FOR CLEAN CONTENT

GEORGE C. LeCOMPTE, MAYNE R. COE, and BETTY L. GOLD

IN determining the clean content of grease wool, a representative sample is cleaned either by a scouring process using warm soap and soda solutions (1), or by a dry cleaning procedure using carbon tetrachloride or trichlorethylene (2). If the latter method is used, a subsequent scouring procedure is necessary.

After the bulk of the impurities have been removed by scouring, or dry cleaning followed by scouring, the remaining fairly small amounts of impurities are estimated by common analytical procedures. The moisture content is determined from the loss in weight exhibited when a sample is heated to constant weight at a standard temperature. The content of wool grease, soaps and other extractives is determined by extracting with ethanol in a Soxhlet apparatus until the bulk of the extractives have been carried down for drying and weighing. The amount of ash is determined by igniting samples in crucibles until a constant weight for the ash has been obtained. Vegetable matter is determined by dissolving the wool and drying and weighing the isolated vegetable matter. Use of correction factors corrects the vegetable matter found to an ash-free and extractive-free basis. These four tests complete the analysis of a scoured sample. Its weight on a standard content of moisture and impurities can then be calculated easily.

The tests for moisture, extractives, ash and vegetable matter are intended to estimate the complete amount of nonwool components present. The tests are, to a large extent, mutually exclusive. There may be a very slight tendency to high moisture determinations due to volatilization of grease during the heating. Also the extractives are found to have an ash in some cases amounting to 4 or 5 per cent of their own weight so that with extractives amounting to 1.5 per cent the determination would be high by from 0.06 per cent to 0.08 per cent. These slight tendencies to duplication and high results in the analyses are relatively unimportant.

There is a more serious tendency to incomplete estimation of the impurities in scoured wool. Past experience has shown that this underestimation of such impurities is not evident in well-scoured wools having a bright, clean appearance. However, the analyses do lead to low estimates of impurities and high estimates of clean wool content when the scoured wool under analysis gives any evidence of poor scouring. It is believed that the factor responsible for the low estimates of impurities in scoured wool is a dust, perhaps similar to humus or top soil, which adheres to the wool fibers, and which cannot be dissolved by ethanol during the extraction procedure and yields relatively little ash during the ignition procedure.

Thorough scouring of samples requires a relatively fresh scouring solution containing from 0.3 per cent to 0.5 per cent soda ash and 0.05 per cent to 0.10 per cent detergent. Temperatures of 120° F. to 130° F. give good results. A very important factor is that the wool should not be crowded during scouring. A ratio of bath to grease wool of at least 100 to 1 should always be maintained. Even if all these conditions are satisfied, however, good scouring will not necessarily be obtained. Some wool samples do not scour readily even under the best conditions. In such cases it has been found that thoroughly clean samples can easily be obtained by drying the scoured wool, giving a mild opening action by hand, and then rescouring mildly in a single bath at 120° F. followed by a rinse. Some experiments were run to demonstrate the points discussed above.

## EXPERIMENTAL DETAILS

Twenty-five hundred grams of Texas fall grease wool were rendered homogeneous by passing it four times through a Wilson-type duster and discarding pieces of tags, burry wool, and cotted wool as the dusting proceeded. Ten replicate 200.0 gram samples were then drawn from the dusted mass, and were weighed rapidly so as to minimize changes in moisture content.

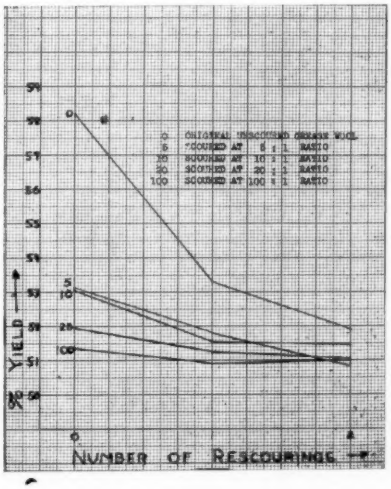
One pair of samples was kept and analyzed without being scoured. The four other pairs of samples were scoured at various ratios of bath to grease wool. The scouring liquors were in all cases composed of 0.5 per cent $Na_2CO_3$ and 0.05 per cent detergent, and were maintained at a temperature of 125° F. to 130° F. The samples were given three one-minute scours with intermediate squeezings on a large Buchner funnel, followed by a rinse and a squeezing. The dried samples were analyzed for moisture content, ash content, and extractives content. The clean yield on a basis of 14 per cent nonwool components in the scoured wool was then calculated. The remaining parts of the samples were saved for further testing by the rescouring procedure.

In the rescouring procedure the remainders of each sample were given a single one-minute bath with gentle stirring in clean scouring liquor at a temperature of 120° F. and a bath to wool ratio of 50:1. They were squeezed on the Buchner funnel, rinsed and dried. Moisture, ash, and extractives were determined on the rescoured samples. The parts remaining of each sample were saved for a repeated rescouring test. The second rescouring was exactly similar to the first.

## RESULTS AND DISCUSSION

The results obtained are summarized in Table 1, Figure 1, and Figure 2. In Figure 2 especially, it is evident that the methods of analysis were not capable of estimating the full amount of impurities present in wools not rescoured and hence that they led to incorrectly high yields. These results were most serious in the

*Fig. 1—Clean Yields vs. Number of Rescourings.*



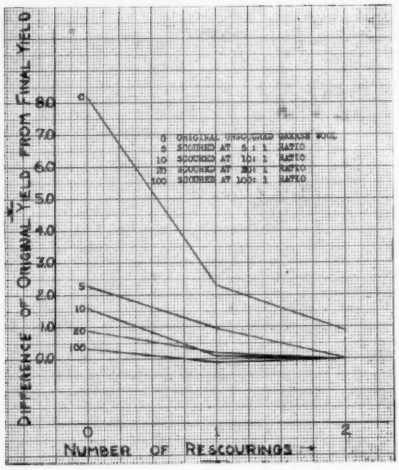



*Fig. 2—Differences of Original Yield from Final Yield vs. Number of Rescourings.*

case of the unscoured sample where the analysis led to clean yields that were too high by about 7.2 per cent and in the case of the sample scoured at a bath to wool ratio of 5:1, where the clean yield was too high by 2.3 per cent. However, in *all* cases the sample yields were too high as evidenced by the lower yields on subsequent rescouring.

The second point to notice in Figure 2 is that a single rescouring followed by analysis yielded nearly correct results for all samples that had been fairly well cleaned previously. Only the excessively dirty unscoured and 5:1 ratio samples could not be corrected sufficiently. The 10:1, 20:1, and 100:1 samples exhibited no significant change in clean yield on further rescouring. This demonstrates that just as wool can be brought to constant weight during a condition test, so it can be brought to constant weight during rescouring tests. As further evidence of the necessity of rescouring in obtaining correct yield of samples of grease wool, a series of tests were run, in duplicate, both with and without rescouring. These results are presented in Table 2. It will be noticed from this table that with these wools the rescouring invariably resulted in lower clean yields. The analyses without rescouring are quite consistent on check determinations. The rescouring tests are the only criteria to demonstrate that small but persistent errors were obtained without rescouring.

Well scoured wools yield correct results when subjected to analysis without rescouring. Poorly scoured wools require a rescouring in order to ensure the correctness of celan wool content determinations on such wools. It appears desirable to make a rescouring process an integral part of a clean wool content determination. The most convenient way to do this is to weigh out the moisture content determination sample, rescour it, and have the subsequent conditioning test cover both moisture and losses of impurities due to rescouring.

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2. Wollner, H. J. and Tanner, L., Industrial and Engineering Chemistry, *13*, Page 883, 1941.

*TABLE 1*

*Clean Yields of Wool Samples Before and After Rescouring*

| Sample | CLEAN YIELD Before Rescour. | After 1st Rescour. | After 2nd Rescour. | Difference of Yields After 1st and 2nd Rescour. |
|---|---|---|---|---|
| Unscd. Gr. Wool | | | | |
| Sample A | 57.50 | 53.10 | 51.90 | |
| Sample B | 58.90 | 53.50 | 51.90 | |
| Average | 58.20 | 53.30 | 51.90 | —1.40 |
| 5:1 Scd. Wool | | | | |
| Sample A | 54.10 | 52.40 | 51.20 | |
| Sample B | 52.20 | 51.20 | 50.50 | |
| Average | 53.15 | 51.80 | 50.85 | —0.95 |
| 10:1 Scd. Wool | | | | |
| Sample A | 52.80 | 51.30 | 51.30 | |
| Sample B | 53.30 | 51.80 | 51.60 | |
| Average | 53.05 | 51.55 | 51.45 | —0.10 |
| 20:1 Scd. Wool | | | | |
| Sample A | 51.60 | 51.00 | 50.70 | |
| Sample B | 52.30 | 51.50 | 51.40 | |
| Average | 51.95 | 51.25 | 51.05 | —0.20 |
| 100:1 Scd. Wool | | | | |
| Sample A | 51.30 | 51.00 | 51.00 | |
| Sample B | 51.40 | 50.80 | 51.00 | |
| Average | 51.35 | 50.90 | 51.00 | +0.10 |

*TABLE 2*

*Comparisons of Clean Content Determination Run in Duplicate Before and After Rescouring*

| Lot No. | Clean Contents—% Before Rscouring Sample A | Sample B | Ave. | After Rescouring Sample A | Sample B | Ave. | Difference of Averages |
|---|---|---|---|---|---|---|---|
| A-23 | 38.90 | 38.80 | 38.85 | 38.60 | 38.70 | 38.65 | —0.20 |
| A-67 | 40.00 | 40.05 | 40.03 | 39.65 | 39.15 | 39.40 | —0.63 |
| A-1415 | 39.80 | 39.70 | 39.75 | 39.40 | 39.40 | 39.40 | —0.35 |
| A Ave. | 39.57 | 38.52 | 39.54 | 39.22 | 39.08 | 39.15 | —0.39 |
| B-1819 | 44.80 | 45.00 | 44.90 | 44.20 | 44.20 | 44.20 | —0.70 |
| B-2223 | 47.85 | 47.85 | 47.85 | 46.80 | 47.15 | 46.98 | —0.87 |
| B-3031 | 46.40 | 46.40 | 46.40 | 44.70 | 45.30 | 45.00 | —1.40 |
| B Ave. | 46.35 | 46.42 | 46.38 | 45.23 | 45.55 | 45.39 | —0.99 |
| C-3435 | 45.40 | 45.20 | 45.30 | 45.10 | 44.20 | 44.65 | —0.65 |
| C-3839 | 47.35 | 47.05 | 47.20 | 46.85 | 46.50 | 46.68 | —0.52 |
| C-4647 | 47.90 | 47.90 | 47.90 | 47.10 | 47.30 | 47.20 | —0.70 |
| C Ave. | 46.88 | 46.72 | 46.80 | 46.35 | 46.00 | 46.18 | —0.62 |
| Grand Ave. | 44.27 | 44.22 | 44.24 | 43.60 | 43.54 | 43.57 | —0.67 |

## SUMMARY

Evidence has been presented on the following points:

1. Analysis of scoured wools may lead to low estimations of residual impurities and high estimation of clean wool content.

2. A rescouring procedure on scoured wool results in better estimation of impurities and of clean wool content.

3. A thoroughly cleaned wool sample maintains constant weight during the rescouring procedure described.

4. A standard method of rescouring as an aid to more accurate clean content determination has been presented.

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# Review of
# CURRENT TEXTILE PROGRESS

A. J. HALL, B.Sc., F.I.C., F.T.I.

THOSE interested in the mothproofing of furs will find much useful information on this subject in a lecture by Traill, McLean, and Bovingdon (Chemistry & Industry, 1944, 32, 284). But actually the subject of mothproofing is of interest to everyone for it is estimated that damage done to textiles by moths throughout the world is very considerable and most probably exceeds £1,000,000 per annum.

These authors summarize the life history of a moth as follows. Each female moth lives about one to three weeks and in this period lays about 75 eggs; these are laid singly and there is evidence to show that the moth prefers to lay them on fluffy material which is soft. Each egg is about 1/24th of an inch in length and at a temperature of 68° F. larvae emerge from these eggs at the end of 7 to 10 days. These larvae at once commence to eat protein material around them and in the course of a few weeks they consume many times their own weight of material and eventually become 200 to 300 times their original size.

Moth larvae prefer to live out of the light and so are frequently found hidden in the folds of fabric. The undigested portion of their food is excreted in the form of small pellets.

When the larvae reach maturity they enclose themselves within white cocoons and within two to three weeks fresh moths emerge from these to commence again the life cycle just described.

The important feature of this life history is, of course, the development of the larvae for the adult moths do not eat fur or wool and so do not cause damage. It is the larvae which eat these keratin substances and they do so greedily.

To guard against this damage by moth larvae two main methods have in the past been employed and they have been applied particularly to wool materials. In the first method, the wool material is treated with colorless substances such as pentachloro-dihydroxy-triphenyl-methane which have properties similar to acid wool dyes so that they are readily absorbed and retained by the wool. In the second method, inorganic salts, particularly those derived from hydrofluoric acid, are used for impregnating the wool. In both cases the wool is thereby made obnoxious to the wool larvae so that these die either by poisoning or by starvation.

Now comes a chance observation that keratin fiber materials are made mothproof to a high degree by treatment with a saturated solution of sodium chloride containing small concentrations of formaldehyde and hydrochloric acid. This line has been followed up and the conditions established whereby fur materials especially can be made highly resistant to moth attack. Traill, McLean, and Bovingdon are now able to give an account of the various experiments carried out and the results obtained. Ultimately a process of mothproofing was devised which forms the subject of E. P. 548061.

Some idea of the way in which protection to rabbit fur can be obtained using this treatment can be formed from the results of experiments in which fleshed rabbit skins were treated for two days at 35° C. with saturated solution of sodium chloride containing about 1 per cent of formaldehyde and various amounts of hydrochloric acid or caustic soda to secure different pH values. The skins were then treated on the flesh side with a mineral oil-fat-liquoring agent and dried. After this they were placed with moth larvae under suitable conditions for several days and the growth of the larvae and the degree of attack on the fur determined. The results obtained were as follows:

| *pH of liquor* | *% Amount of fur damaged* |
|---|---|
| below 2.0 | 16.7 |
| 5.5 | 69.9 |
| 9.5 | 82.7 |
| Control liquor containing only NaCl and at pH 6.7 | 87.3 |

It appears that for the fur to be toxic to the moth larvae it is necessary that the salt and formaldehyde treatment should be carried out at a low pH of say around 2.0.

In the above trial the fur was brought in contact only with larvae whereas under ordinary circumstances moth have first to lay eggs on the fur so that these can later hatch into larvae. So to imitate more exactly these natural conditions the following very interesting trial was carried out.

A piece of black woolen cloth (black was chosen so that eggs and larvae deposited on it could be more clearly seen) was cut into two halves. One half was treated with the salt, formaldehyde, and acid liquor as described above while the other half was treated with a saturated salt solution only. These samples were then dried and portions of each (five trials were carried out so as to secure an accurate average result) were placed in glass jars with 20 adult moths. After ten days the cloths were examined to ascertain the number of moth eggs and larvae present and the following results were obtained:

| *Trial* | *Treated cloth* | | *Untreated cloth* | |
|---|---|---|---|---|
| | *No. of eggs found* | *No. of larvae found* | *No. of eggs found* | *No. of larvae found* |
| 1 | 9 | 17 | 86 | 125 |
| 2 | 1 | 3 | 54 | 92 |
| 3 | 15 | 21 | 74 | 95 |
| 4 | 0 | 4 | 82 | 77 |
| 5 | 6 | 4 | 67 | 89 |
| Totals | 31 | 49 | 363 | 478 |
| Combined totals | 80 | | 841 | |

On noting these results it is to be observed that moths show a decided reluctance to lay eggs on the treated woolen cloth. Actually the number of eggs laid on the untreated material was over ten times as great as the number laid on the treated material.

This result is not only of great importance but it is interesting in contrast with other methods of mothproofing in which it has been found that although the mothproofing agent is toxic to the moth larvae it may also have the effect of stimulating the moths to lay more eggs and thus partly neutralizes the beneficial effect of the mothproofing treatment.

Further experiments showed that fur dyed with oxidation dyes such as Durafur Dark Brown 2G, Durafur Brown RB, Durafur Black R, and Durafur Grey BG (all made by I.C.I. Ltd.) did not impair the mothproofing action of the sodium chloride-formaldehyde-hydrochloric acid treatment.

The authors of this new mothproofing treatment consider that it is more applicable to furs than to wool materials since it can be easily and cheaply incorpo-

rated in the normal fur pickling processing. For furs they consider it to be a cheap and efficient mothproofing treatment.

## PURIFICATION OF HIGHER FATTY ACID ESTERS OF CELLULOSE

The manufacture of the lower fatty acid esters of cellulose, particularly cellulose acetate, has now been so perfected that it is quite easy to obtain a pure ester. But it is otherwise with the higher fatty acid esters such as cellulose stearate or palmitate. In making these esters considerable difficulty is experienced in isolating them in a pure state free from unreacted fatty acid.

According to E.P. 562691 these difficulties attending isolation of the cellulose ester may be overcome by employing a special technique involving extraction of the crude product of esterification. The essential feature is to use in the extraction an aqueous solution of a lower fatty alcohol (ethyl or propyl alcohols are especially suitable) of such concentration that it is able to dissolve the unreacted fatty acid but not at the same time soften or dissolve the cellulose ester.

In the first place the esterification process will most probably consist of reacting together cellulose acetate and stearic anhydride in the presence of zinc chloride and hydrochloric acid as catalysts. In the reaction which ensues the stearic acid residue replaces part of the acetic acid residue already combined with the cellulose and so there results a cellulose stearate or more generally a cellulose acetate-stearate mixed ester. If palmitic anhydride is used under similar circumstances then a cellulose acetate-palmitate mixed ester is obtained. But in both cases the crude product contains an excess of the fatty acid or fatty acid anhydride—stearic or palmitic acid as the case may be. And in order to make the process of esterification more economic it is desirable to recover this fatty acid and use it again.

If the crude product is simply extracted with an organic solvent capable of dissolving the fatty acid and not the cellulose mixed ester then it is found that although the latter substance remains substantially insoluble yet a small amount of it is extracted with the fatty acid. Then in making fresh cellulose ester using this recovered fatty acid complications occur and the resulting cellulose ester lacks clarity and purity. This difficulty is avoided by using the following method.

The crude cellulose acetate-stearate mixed ester product obtained as indicated above will contain 20 or 30 per cent of free stearic acid according to the conditions of its preparation. It is therefor extracted with an aqueous solution of ethyl alcohol whose concentration will vary according to the temperature at which the extraction is carried out. The most satisfactory limits are as follows:

| *Temperature of extraction* | *Ethyl alcohol content of extracting liquor* |
|---|---|
| 50 to 80°C. | 55 to 80% |
| 30 to 50°C. | 65 to 85% |
| 20 to 30°C. | 70 to 85% |

Optimum conditions are to extract at 35 to 50° C. with 65 to 75 per cent aqueous alcohol.

If concentrations of alcohol higher than those recommended are used then there is the risk of contaminating the extracted fatty acid with some of the cellulose ester. If lower concentrations are used then larger volumes of the extracting liquor are required and this involves additional trouble and expense.

After the extraction has been carried out then it remains to free the residual ester cellulose from adhering alcohol. This may be achieved by simply drying it when the alcohol evaporates. But it is preferred to wash out the alcohol with water first; in this manner the washing liquors can be collected and the alcohol recovered from them.

Those interested in details for preparing the cellulose mixed esters should refer to E.P. 543311.

## IMPROVED METHOD FOR DIFFERENTIATING GELATINS AND GLUES

Gelatin and glue are frequently used in dyeing and finishing either as protective colloids (as in vat dye liquors) or as stiffening agents. It is important to have tests available for distinguishing between the different qualities being sold.

Simple tests which are in current use compare different products by measuring the viscosities of their solutions under standardized conditions or by determining the setting points of their solutions. But it frequently happens that these tests are not sufficiently sensitive to reveal differences of importance to the dyer or finisher of textile materials. In this case it is useful to note a paper by Steigmann (J. Soc. Chem. Ind., 1944, *63*, 96) which describes modifications of these tests so as to make them more accurate and sensitive.

In the setting test use is made of an addition of urea to the gelatin or glue solution. Thus the test should be carried out in the following manner. Twenty grams of the gelatin or glue powder are added to a solution of 30 grams of urea in 50 c.c. of water. The mixture is stirred for 1 to 3 hours at 25° C. until dissolution is complete. It is then cooled to 15° C. and the pH adjusted to 6.5.

Twenty c.c. of this solution are added to 60 c.c. of water at 15° C. with stirring (this takes about 10 seconds) and the time for setting to ensue is then taken using a stop watch and stirring from time to time. Meanwhile the temperature is maintained at 15° C. Different qualities of gelatin or glue will thus be differentiated by the different times taken for their solutions to set. The effect of the urea is to make these differences greater than they otherwise would be. For instance, two qualities of gelatin which had the very similar setting points of 23° C. and 24.5° C. could be clearly distinguished in the above setting test since their solutions (with urea) took 12 minutes and 6¼ minutes to set respectively.

In the viscosity test use is made of Teepol (a proprietary wetting-out agent sold by the Shell Petroleum Company). The addition of this to a solution of glue or gelatin increases its viscosity considerably and so makes it possible to differentiate more easily between products which yield ordinary water solutions having about the same viscosities.

The test is caried out by adding 4 c.c. of undiluted Teepol solution to 50 c.c. of a 6.66 per cent solution of the gelatin or glue at 40° C. and the viscosity measured at this temperature. The following data indicates how the addition of Teepol is effective:

| *Product under test* | *Viscosity in centiposies* | |
|---|---|---|
| | *Without Teepol* | *With Teepol* |
| Technical low grade gelatin.. | 3.1 | 9.6 |
| Baryta gelatin ..... | 5.1 | 29.6 |
| Another baryta gelatin..... | 5.4 | 36.2 |
| Photographic gelatin ..... | 6.6 | 60.0 |

Actually the maximum effect of Teepol is obtained when 6.25 c.c. of the undiluted Teepol is added to the gelatin solution.

## THE DYEING OF THE NEWER RAYONS

A lecture with the above title has recently been delivered by C. M. Whittaker (Chemistry & Industry, 1944, *30*, 269) and it covers a great deal of ground in so far as it describes dyeing procedures for many fibers including nylon, alginate rayon, Rayolanda (Courtaulds), and casein fiber.

Whittaker gives many facts which show the newer fibers to be a challenge to the technical skill of the dyer but in meeting this challenge it is all important that the dyer recognizes the Golden Rule that in dyeing compound shades only those dyes which dye at the same rate should be used together.

Referring to the dyeing of viscose rayon interesting facts were given concerning the coloring of this type of rayon while in the form of "cakes" (as taken from the Topham centrifugal spinning box—patented by Topham in 1900) and also in the spinning process. A cake of freshly spun viscose rayon contains about 15,000 yards of yarn and weighs 16 to 20 ounces. It can now be dyed in this form and this makes the dyeing of yarn in skein form comparatively much more expensive and almost non-competitive. But, of course, many difficulties have had to be overcome

before success in this particular form of dyeing was secured. The quality of the dyed yarn is also much superior.

By adding colored substances to the viscose spinning solution it is possible to produce colored rayon at a very cheap price and, so it seems, much lower than could be achieved by ordinary dyeing methods. Moreover, this method allows very fast shades to be produced. For example, if carbon black is used to color the spinning solution and so produce black viscose rayon the fastness so obtained is superior to that obtainable with any coal tar dye. It is anticipated that after the present war "spun dyed Fibro" will be produced in enormous quantities.

In dealing with Rayolanda Whittaker suggests that this animalized type of viscose rayon has now established for itself a niche in the textile industry and that it is superior to Fibro in respect of firmness of handle. Ordinary Fibro has a somewhat raggy handle which is considerably improved when made crease resistant by the process invented by Messrs. Tootal Broadhurst Lee Co. Ltd. Whittaker states that Rayolanda has this desirable handle apart from such treatment.

But the essential property of Rayolanda is its affinity for wool dyes. It may be dyed with the majority of the dyestuffs which are normally applied to wool but it is necessary to qualify this by noting that some of the dyes give shades on Rayolanda which are not so fast to light as those similarly produced on wool itself. Such defective dyes are mainly to be found among the ordinary acid wool dyes. But chrome dyes are almost all completely satisfactory on Rayolanda from this viewpoint of fastness to light.

Dyers will do well to note that Rayolanda gives heavier shades than Fibro with many direct cotton dyes. However by adjusting the conditions of dyeing it is possible to dye a Rayolanda-Fibro mixture material so that the two fibers acquire the same depth of shade or the Rayolanda is more heavily colored.

In dyeing mixtures of wool and Rayolanda with Neolan dyes the presence of tannic acid in the dyebath can determine whether the two fibers are dyed to the same depth of shade or whether one or the other is dyed heavier.

The specially solubilized types of vat dye such as the Soledons dye Rayolanda much heavier than they do Fibro and thus it is easily possible to produce beautiful stripe effects in the mixture fabric by dyeing in the piece with these dyes.

Rayolanda has no affinity for acetate rayon dyes and this is of considerable assistance to the dyer of Rayolanda-acetate rayon mixture materials.

Whittaker has carried out a large amount of research on the dyeing of nylon and he is able to give useful information on this subject.

Two points about nylon are important. The first is that it only absorbs about 14 per cent of water when wetted. The other is that it shows but little affinity for any dye below about 70° C.

Although nylon has hitherto been most satisfactorily dyed by means of the acetate rayon dyes the behavior of this new fiber towards direct cotton dyes is important in so far as in the post war period mixtures of nylon with cellulose fibers will have to be colored. On the whole, nylon has a poor affinity for most direct dyes but this affinity is increased by carrying out the dyeing in a bath acidified with acetic acid. Unfortunately some direct dyes such as the blacks are insoluble under these conditions.

Courtaulds have devised four different methods for assisting the absorption by nylon of direct dyes but all of them cause a shrinkage (up to 10 per cent) in the length of the nylon threads being dyed. These methods are covered by E.P. 550724, 558586, 556925 and 547844.

Chrome dyes give excellent results on nylon and Grundy (J. Soc. Dyers and Col., 1944, *60, 205)* has pointed out that many of the shades so produced are fast to bleaching with active chlorine. These shades may also be fast to the boiling-off process. Chrome dyes may be applied to nylon by the top-chroming method but the chrome bath must be kept near to the boil in order to obtain complete development of shade. Also more bichrome is required for nylon than for wool dyeing.

Vat dyes are very disappointing on nylon since they do not give so high a degree of light fastness on this fiber as on cotton. Until this fault is corrected it will not be possible to use vat dyes for nylon casement fabrics. Caledon Yellow G is a particularly poor vat dye on nylon; it gives shades which have the defect of being phototrophic and which turn greenish in a subdued light.

So far, only a moderate amount of experience has been obtained in the dyeing of alginate rayons. It is easy to understand this for it is only within the past three or four years that this type of rayon has been manufactured on a large scale. Alginic acid (the constituent of seaweed from which the rayon is made) is soluble in alkalis so the rayon is actually made of a salt of this acid. The beryllium salt has so far proved most satisfactory; the calcium and sodium alginates are soluble in soap. Chromium aliginate is insoluble but rayon made of this has a greenish color.

Chromium and beryllium alginate rayons can be dyed with mordant dyes and if pre-treated with Fibrofix (Courtaulds) these rayons have an affinity for some direct cotton dyes. Otherwise these rayons cannot be dyed satisfactorily with cotton, acid, acetate rayon, or Neolan dyes.

Casein fiber such as Lanital and Aralac may be dyed with all the dyes usually applicable to wool but the fastness to washing of the resulting shades is not so good as those produced on wool. Molecularly dispersed dyes especially fail to give fast to washing shades on casein fibers. But by using aggregated types of acid dyes and chrome dyes satisfactory shades can be produced. A noticeable difference between wool and these casein fibers is that the latter have an affinity for dyes at much lower temperatures than is the case with wool.

Casein fibers have been found especially suitable for mixing with wool in the manufacture of felt hat bodies. It seems that in the felting process the casein fibers migrate into the bodies so as to leave the wool on the outside. A useful blend for this purpose contains 20-25 per cent of casein fiber and 80-75 per cent of wool.

It is found that blends of casein fiber with Fibro give fabrics which have a fuller more wool-like handle than those made with Fibro alone, and it is anticipated that this advantage will be exploited in the near future.

## IMPROVING THE WEAR OF LADIES' RAYON HOSE WITH RESINS

Increased wear and a good degree of resistance to laddering are obtained according to E.P. 561152 by treating ladies' rayon and rayon-cotton hose with liquors containing synthetic resins present in the form of comparatively coarse particles. Under these conditions the particles do not enter into the individual fibers but rather remain on the outside so as to produce a partial interlocking of the stitches. The knitted structure is thus made more resistant to abrasion and snatching.

Various synthetic resins may be used for this purpose, it merely being necessary to bring them to the correct particle size. In general this can be carried out by adding to a solution of the resin a substance capable of causing coagulation. The following is an example of the method used.

The treating bath is prepared with a methacrylate resin known as "Methacrylate NH Emulsion." Thus in 16 lbs. of warm water containing 3 ozs. of a 5 per cent solution of a stabilizer having a basis of fatty alcohol sulfonate is added 1 oz. of the Methacrylate resin emulsion, 1 oz. of a 40 per cent clay dispersion, and 5 ozs. of a 3 per cent solution of gelatin. After stirring well a further addition of 3 lbs. of a 33 per cent solution of ammonium sulphate is made and this causes the resin to agglomerate to form coarse particles. These particles are seen when the liquor stands, to settle in the form of a floc.

At this stage one dozen pairs of all-

rayon ladies hose are entered and worked about in the liquor for ten minutes. An addition of 1¼ oz. of 10 per cent formic acid is made and further additions of 2½ ozs. of this same acid made at the end of 20 and then 30 minutes. After immersion in this bath for a total period of 45 minutes the hose are withdrawn, rinsed in water, and dried on metal shapes in the usual manner.

After such treatment it is found that the hose have gained 3 per cent in weight and have very good resistance to wear and laddering.

Much the same treatment can also be applied to hose made with nylon, acetate rayon, silk, wool, etc.

# ABSTRACTS FROM CONTEMPORARY JOURNALS

*SYMPOSIUM ON SOME NEW INSTRUMENTS AND TESTING METHODS, Journal of the Society of Dyers and Colourists*, page 161, Vol. 61, No. 7, July, 1945.

This symposium was conducted at a meeting of the West Riding Section of the Society of Dyers and Colourists held on January 11th at the Victoria Hotel, Bradford. The following papers were presented:

*Electronic Apparatus in Textile Testing.* N. H. Chamberlain. This paper discusses photoelectric methods and methods depending on the measurement of electrical capacity. Examples of the application of these methods to textile testing are given. The author concludes that: "The thermionic valve, photoelectric cell and gas-filled relay, when suitably applied, can not only increase the precision of testing methods, but can also save a very large amount of time, energy and strain. Their application not only in the field of specialized laboratory precision work, but in ordinary routine testing by semi-skilled and unskilled operators, has much to recommend it. Only the fringe of such applications has yet been explored, and the great potentialities of these powerful tools in this field are as yet unexploited."

*Chromatography,* F. R. Cropper. The use of chromatography in the separation of the components of a mixture depends on the differences in the degree of absorption of the various components by a suitable absorbent. The mixture is added to the top of a vertical column of a suitable absorbent and the column is washed with solvent so that the components travel down the column at different rates and ultimately become separated from each other in distinct zones or bands. The rate of movement of a zone depends not only on the adsorptive properties of the absorbent, and on the solvent, but also on the molecular size and constitution of the adsorbed material. Many different adsorbents have been used but activated alumina is the most popular.

A number of examples of the use of chromatography for testing materials used with textiles are given.

*The Polarograph,* S. Matthews. The Polarograph is a tool for the measurement of solutions. It depends upon the reduction or oxidation (in an electrochemical sense) of substances in solution, at a dropping mercury electrode. The apparatus in its elementary sense consists of (1) the dropping mercury electrode which is a fine-bore glass tube with its upper end connected to a supply of mercury and its lower end dipping into the solution to be analyzed; (2) a means of applying a known variable potential between the solution and the mercury of the dropping electrode; and (3) a galvanometer for measuring the current.

*Tensimetric Analysis of Surface-Active Electrolytes,* J. M. Preston. A method of analysis is given to determine an anion-active substance in terms of a known cation-active substance, or conversely. The change in surface tension during a titration is determined by employing a modification of the standard bubble pressure method. At the equivalence point where there is a complex formed with a 1:1 ratio of anion to cation, there is a sudden and marked fall in the bubble pressure. The end-point is extremely sharp and shows good reproducibility. A description of the apparatus and method of titration is given.

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*SOME CHARACTERISTICS OF BEMBERG YARNS AND FABRICS OF INTEREST TO THE DYER AND FINISHER,* W. L. Ashby, *Journal of the Society of Dyers and Colourists*, page 167, Vol. 61, No. 7, July 1945.

The first portion of this paper is concerned with the details of the manufacturing process and with the types and applications of Bemberg yarns.

*Dyeing*—Bemberg fabrics have a high affinity for dyes and it is necessary to have some measure of control over the dyeing process to prevent the dye rushing on to those parts of the fabric first coming in contact with the dye-liquor. Reference is made to a temperature range grouping of direct dyes in which they are classified according to their temperatures of maximum affinity. Hints for successful application of the various groupings are given. The use of the Soledon (I.C.I.) dyes is also discussed. When vat dyes are used, it is suggested that the vatted dye be added in several lots, the use of salt avoided, and a restraining or retarding agent employed. Azoic dyes present no great difficulties when applied to Bemberg, the affinity being similar to that on viscose rayon when applied without salt. During dyeing, friction should be reduced to a minimum. Where heavy fabrics are likely to slip, it is often advisable to wrap the winch with cotton cloth. The most suitable winch machine is one in which maximum immersion is secured.

In respect to printing the thickener used is of primary importance. It is stated that probably the most suitable thickening is one made entirely from gum tragacanth as this gives a soft and pliable film. Mixtures of other thickening materials with the gum tragacanth will probably be used in most instances. Overdrying the printed goods must be avoided. The use of various dyestuffs, and screen and block printing are discussed.

*Finishing*—Light fabrics may be hydroextracted and followed by hand scutching before drying. Flat cloths should undergo full-width suction extraction. Drying may be carried out over a can drying range, in a festoon dryer or on a stenter. The drying process should be slow so that the filaments will not adhere to each other but will be capable of individual movement. It is important to allow the cloth maximum shrinkage during the last drying process.

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*INDUSTRIAL RESEARCH,* R. C. Swain, *Canadian Chemistry and Process* Industries, page 479, Vol. XXIX, No. 7, July 1945.

This is an abstract of an address to the Canadian Manufacturers Association in Toronto on June 5th, 1945 as printed in the publication mentioned above. The speaker is associated with the American Cyanamid Co. in New York.

The growth of industrial research in America has been a feature of the twentieth century, although facilities were nonexistent at its start. In 1900 the three or four thousand chemists in the United States were sufficient to serve existing industrial and academic laboratories. The Great War emphasized the almost fatal

lack of many essential chemicals previously imported. Growth of American research facilities dates from that period: the 297 industrial laboratories staffed by 7,400 technical men of 1920 had increased by 1940 to over 2,300 laboratories with 70,000 chemists, engineers, physicists, etc. Over 1,000 applications for permission to build new laboratories or major extensions are filed in Washington. Research and development budgets total millions of dollars annually.

Realization that orderly interpretation of chemical facts and painstaking laboratory work can yield almost predictable results probably accounts for the extensive subsidy of these activities by industry. No industrial laboratory can have extended existence without showing a profit on the investment in it.

The chemical industry will probably continue to be highly competitive. A given operation may suddenly become unprofitable through the discovery of a better product or more economical process.

This constant threat is an incentive for constant investigation of alternative production methods. Expanded research programs to open new fields are only profitable when certain essential steps are recognized and followed. Distribution of samples of new materials in the hope that some use may be found yields small returns. A chemical research laboratory must have adequate testing faciilties to obtain accurate information on new compounds. The importance of such testing has led to a technical service department in most laboratories. Frequently the attempt to solve a well-defined problem yields a new chemical of chief use in another field. Such by-products of organized research are recoverable only if broad screening tests are available in a number of fields.

Industrial research will have to face problems resulting from the necessity of concentration on war researches, which has almost stopped accumulation of fundamental information on which long-range progress depends. In the United States the education of trained men has almost ceased. To train a chemist requires four to seven years and acceleration is impracticable. The distinct shortage of chemists —estimated at 15,000 to 20,000 by 1950 even with immediate cessation of the war —makes essential and immediate rebuilding of dislocated university faculties. Industry must help in this effort.

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*CLOTH CONSTRUCTION AND DYEING FAULTS, The Dyer and Textile Printer,* page 17, Vol. XCIV, No. 1, July 6, 1945.

Certain faultily dyed cottons and cotton-viscose mixtures are due to particular types of fabric. There are imperfections present in the finished cloth which have, to a great extent, been caused by the influence of the fabric construction. This article is concerned chiefly with vat and sulfur dyeings.

*Oxidation Stains*—A kind of staining, caused by uneven oxidation, often occurs, mostly on jig dyed goods. The oxygen is taken into the roll of goods during dyeing. Ribbed cloths are particularly bad offenders because of the ease with which air gains access into the rolls of cloth near the selvedges. Poplins and ribbed cloths have a poor liquor holding capacity and sufficient liquor is not held by the cloth to counteract and prevent the flow of atmospheric oxygen. Many kinds of cloth made from hard spun and doubled yarns are easily oxidized during the dyeing process if the roll of cloth ceases to rotate. Certain cloths which have a large liquor capacity may cause trouble when the rolls of wet cloth stop revolving. Drainage is very rapid and air is sucked into the higher parts of the rolls with consequent oxidation. Air may also gain access to the cloth being dyed by way of the seams. Another type of oxidation staining is caused by the trapping of a large air bubble under the cloth as it winds onto the roller after passing through the dyebath.

Many of the types of oxidation staining are difficult to avoid. However, there should be sufficient excess of reducing agent to take up any free oxygen without interfering wtih the dyeing. Some stains may be removed by further passages through the dyebath.

*Unlevel dyeing*—In jig dyeing the cloth is in contact with the dyebath for only a small part of the dyeing time; dyeing takes place mostly on the roller and the quality of the dyeing is, therefore, directly affected by conditions prevailing on the roller. It is difficult to control the distribution of the dye liquor throughout the roll as this depends almost entirely on the cloth type. Difficulties usually occur with cloths which are woven with satin or corded stripe designs. During dyeing the tendency is for the liquor to be squeezed from the harder to the softer sections with the result that the soft sections have a greater opportunity to take up dyestuffs.

*Bad Penetration*—It is difficult to circulate dye liquor in cloths made from hard spun and doubled yarns. Penetration into the interstices is poor so that surface dyeing results. Listing occurs mostly when dyeing the tightly spun and woven cloths. The dye liquor rides on the surface of the cloth where it is taken up rapidly.

Many of the difficulties caused by cloth construction may be eliminated by modifications in processing. The pigment pad method of dyeing may give better results. The use of a retarding agent may also be helpful.

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*WATER TIGHT FABRICS MADE BY SWELLING COTTON FIBERS,* Charles F. Goldthwait and Herbert O. Smith, *Textile World,* page 105, Vol. 95, No. 7, July, 1945.

Linen fire hose is a common example of using a fabric of special construction to hold water without the aid of rubber or other water-proof coating. The principle involved is that "when water under pressure is transmitted through such hose, there is leakage through the hose wall at first; but the wet fibers swell quickly, fill the interstices within the fabric wall structure, and make the wall so nearly water-tight that it serves as a very satisfactory fire hose." The same principle allows for the construction of water bags which cool the water through evaporation of water seeping through, and linen canvasses which resist leakage by means of swelling of the fibers.

The supply of linen during the war was expected to be insufficient and tests were conducted at the Southern Regional Research Laboratory with the idea in mind of substituting cotton for linen. It was found necessary to use a supplementary swelling material with cotton in order that the desired effect would be attained. The material most used in the experimental work was a commercial hydroxy ethyl ether of cellulose, soluble in caustic alkali but not soluble in water. It was found that cotton yarn containing 6 to 7 per cent of the product would give results equal to linen. Tests were conducted on woven fabrics, similar in structure to fire hose. The best pieces, made from yarn containing the swelling product, did not leak at all when submitted to water at 100 lb. pressure in direct contact. Tests on hose indicated that they would transmit water under pressure of 55 to 60 lb. without undue leakage.

Tests conducted by the Shirley Institute indicated that merceriezd cotton could be used for fire hose.

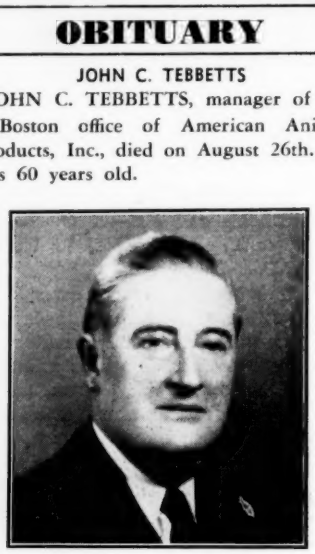
The Jeffersonville Quartermaster Depot produced a water bag made by treating cotton duck with a resin and a thickener. The performance of the cloth depends upon swelling.

The article further discusses construction and finishing of suitable fabrics, makes a comparison of linen and cotton, considers the use of rayon and refers to the best type of yarn construction to be used.

## OBITUARY

### JOHN C. TEBBETTS

JOHN C. TEBBETTS, manager of the Boston office of American Aniline Products, Inc., died on August 26th. He was 60 years old.



*John C. Tebbetts*

Mr. Tebbetts was born in Hudson, New York, on July 25, 1885. He was educated in the schools at North Adams, Mass., graduating from Drury High School. He attended Yale University (class of 1906) and later graduated from Philadelphia Textile School. While at Philadelphia he was awarded the Sorbonne Medal as the world's best student dyer.

After gaining experience in various branches of the dyestuff industry he joined the staff of the American Aniline Products, Inc., on February 25, 1918, taking charge of the New York laboratory. Later he was transferred to the Boston branch where he served the New England territory for many years, being made manager of the branch in 1944.

Mr. Tebbetts was a member of Alpha Chapter, Delta Kappa Phi fraternity, Delhouse Lodge, F. and A. M., Newtonville, Mass., the John Clough Society, the Society of Puritan Descendants, and a vestryman of St. John's Episcopal Church, Newtonville, Mass. He was also a member of many technical and trade organizations among which were the American Chemical Society, American Association of Textile Chemists and Colorists, and the Dry Salters of New England.

He is survived by his widow, a son, and a brother.

### • INSPECTION SERVICE MOVES QUARTERS

In line with post war plans, Headquarters, Quartermaster Corps Inspection Service, formerly located at 521 Fifth Avenue, has moved into new quarters at the Army-Navy Purchasing Office at 111 East 16th Street.

Colonel Vere Painter, Deputy Director for Inspection, Procurement Division, Office of the Quartermaster General, is the officer in charge. The Inspection Service, established in October, 1943, controls inspection of all supplies procured by the Quartermaster Corps with the exception of foods, fuels and lubricants.

### • DU PONT EXHIBIT

An exhibit of war materials was arranged by the du Pont Company at Wilmington to give their employes a picture of the ways in which their work contributed to the victory. The chemical products were shown in their final usable form such as airplane tires, storm suits, tents and hammocks, plastic windows, x-ray films, etc. Many of the items were being shown for the first time.

The exhibit showed primarily the incorporation of du Pont materials in the products used by the armed forces, but demonstrated at the same time how the industrial chemist is improving the properties of a great many articles that may be used by civilians. Increased strength, reduced weight, greater flexibility, better resistance to weather and other qualities were imparted by the use of chemical products.

The Fabrics and Finishes Department exhibited an overboard suit, for the protection of sea or airmen when plunged into icy water; a water-resistant sea suit which keeps inner clothing dry; a nylon mountain tent secure against insects and weather. The Organic Chemicals Department exhibited dyestuffs in military clothing; water repellents; self-sealing PT boat gasoline tanks; soapless soap; "Arider" water-resistant chemical for the treatment of fabrics.

### • CALCO BULLETIN

The Calco Chemical Division, American Cyanamid Company, announces the release of Calco Technical Bulletin No. 779, entitled "The Redyeing of Government Olive Drab."

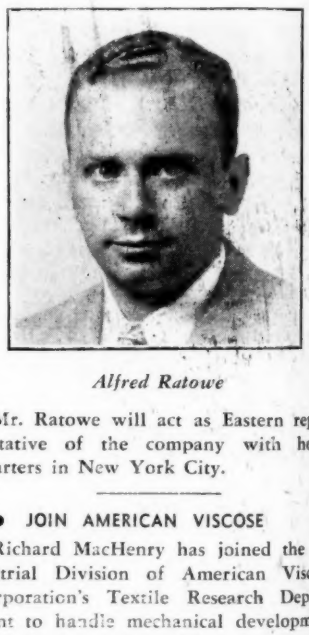
The release of this bulletin is in line with the Calco policy to assist in every way possible the textile dyeing industry to reconvert its production facilities and inventories as quickly as possible to meet consumer demands.

It was early recognized by Calco that any postwar program which might be developed to meet its own problems must necessarily be predicated on the rapid reconversion of the textile industry to peacetime production. It became evident that large quantities of Government Olive Drab and other shades of wool materials would have to be redyed for civilian use. The problem was referred to the Calco Application Laboratories for study. Their recommendations have been made available to the trade with the release of this bulletin.

Copies of the bulletin may be obtained from your Calco representative or by writing to the Advertising Department, Calco Chemical Division, American Cyanamid Company, Bound Brook, N. J.

### • TRANSFERRED TO NEW YORK

Alfred Ratowe has been transferred from the laboratory of Burkart-Schier Chemical Company, Chattanooga, Tennessee, to its sales staff.



*Alfred Ratowe*

Mr. Ratowe will act as Eastern representative of the company with headquarters in New York City.

### • JOIN AMERICAN VISCOSE

Richard MacHenry has joined the Industrial Division of American Viscose Corporation's Textile Research Department to handle mechanical development work in connection with industrial uses of rayon. During the war Mr. MacHenry was acting chief of the design section of the Naval Ordnance Laboratory in Washington, D. C., where he worked in developing countermeasures against the German magnetic mine and other projects. Previously he was with Carbide and Carbon Chemicals Corporation and National Carbon Company. He is a mechanical engineer graduate of Stevens Institute of Technology.

W. T. Boyer has joined the department's Knitting Division and will work as an assistant to Richard F. Eshleman, division head. Mr. Boyer has been a member of American Viscose Corporation's War Procurement Department as supervisor of tool design since 1942. During the previous two years he was

with the U. S. Office of Education as supervisor for instruction of defense workers in machine tool operation. His earlier training was with E. I. du Pont de Nemours & Co. and Textile Machine Works, manufacturers of full-fashioned knitting machinery.

Caroline Boyer has become a member of the educational staff of the Textile Research Department. She was previously with the Combined Production and Resources Board Textile Committee, Washington, D. C., as a research assistant, and prior to that was a textile economic analyst with the O.P.A. and Department of Commerce, and research assistant to the director of textile research, Kansas State College. Miss Boyer holds a bachelor of science degree from Drexel Institute of Technology, and a master of science degree from Kansas State College.

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**• JOINS I. T. T.**

Dr. T. Earl Jordan has joined the staff of the Institute of Textile Technology, Charlottesville, Virginia, as a research associate. Dr. Jordan was formerly at the Barrett Division of the Allied Chemical and Dye Corporation, Philadelphia, Pennsylvania. He holds the B.S. degree from Atlantic University (1931), the M.S. degree from the University of Richmond (1934), and the Ph.D. degree in chemistry from Duke University (1936).

*Dr. T. Earl Jordan*

Dr. Jordan has had diversified research experience in organic syntheses, the field of high polymers, and the engineering of pilot-plant operations. He has taught at Furman University, Greenville, South Carolina and at the Drexel Institute, Philadelphia. Dr. Jordan is a member of the American Chemical Society, the American Institute of Chemical Engineers, and Sigma Xi.

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**• JOINS UNITED ANILINE**

Sidney R. David, after several years retirement, has joined the United Aniline Co., 156 Pearl Street, Boston, Mass., as sales manager.

*Sidney R. David*

Mr. David has spent many years in the dyestuff industry, beginning with the old Farben Fabriken with whom he spent twelve years, both in the laboratory and demonstrating new colors and correcting troubles in the mills. He next went with W. Beckers Aniline and Chemical Works as New England manager. This concern, along with several others, later formed National Aniline and Chemical Co. and Mr. David came to New York as sales manager.

Some time later Mr. David headed his own company, known as S. R. David Company, Inc. After eleven years this company was absorbed by Sandoz Chemical Works and Mr. David became New England manager for Sandoz. For the past several years he has been retired but has now gone back into the dyestuff business.

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**• JOINS ROXALIN**

Roxalin Flexible Finishes, Inc., of Elizabeth, New Jersey, have announced the appointment of Robert Collyer as advertising manager.

*Robert Collyer*

Mr. Collyer has been advertising manager for the Calco Chemical Division and of the Textile Resin Department of American Cyanamid Company.

Mr. Collyer will supervise Roxalin's expanded post war promotion of product finishes and technical coatings engineered from the basic plastics and their co-polymers. Many new coatings developed during the war are now ready for introduction to consumers' lines.

Mr. Collyer's interest in packaging led to the war time development of the life jacket dye marker used extensively by the Army and Navy to speed rescue at sea.

Before joining American Cyanamid Company, Mr. Collyer was an advertising executive of the Chesapeake & Ohio Railroad and a member of several large New York advertising and printing firms.

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**• VICE-PRESIDENT, NATIONAL CARBON**

Election of Dr. Lauchlin M. Currie as Vice-President in Charge of Research of National Carbon Company, Inc., has been announced by A. V. Wilker, President. Dr. Currie has been Acting Director of Research since 1942, except for fifteen months during which he was Associate Director of the Division of War Research of Columbia University.

*Dr. Lauchlin M. Currie*

After receiving his A.B. degree at Davidson College in 1918, Dr. Currie worked for three years, first as a chemist, then as production foreman, with the Hooker Electrochemical Company in Niagara Falls. He then entered Cornell University on a Sage Fellowship and received his Ph.D. in 1925. Immediately afterward he joined National Carbon Company, Inc., as a research chemist in the laboratories at Cleveland.

In 1929 Dr. Currie became the superintendent of National Carbon's Edgewater Works in Cleveland, and in 1931, assistant to the Director of Research for the company. Two years later he was put in charge of the Vinylite Division of National Carbon Company which led in 1941 to his appointment as Superintendent of the Vinylite Division of Bakelite Corp. Both companies are units of Union Carbide and Carbon Corporation. He returned

to National Carbon Company, Inc., as Acting Director of Research in 1942.

A member of the American Institute of Chemical Engineers and of the American Chemical Society, Dr. Currie was at one time chairman of the Cleveland Section of the latter organization. He is on the Board of Editors of the American Society for Testing Materials and was one of the organizers of that body's Plastics Committee D20.

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### ● DU PONT NYLON CHANGES

The Rayon Department of the Du Pont Company has announced organization changes in its Nylon Division, creating a Wilmington Nylon District Sales Office headed by P. D. Atwood, and a Nylon Technical Service unit, headed by A. W. Staudt, also with headquarters at Wilmington. The changes were effective September 1.

Temporarily, the Wilmington District Sales Office will handle nylon sales until such time as the branch sales offices can be reestablished. They were discontinued after all nylon production was directed into military applications early in the war.

The Nylon Technical Service unit will take over nylon product development work formerly directed by Mr. Atwood. It will conduct hosiery wear testing and similar evaluations of other products made of nylon, and will coordinate work between nylon research and production and customers' mills in evaluating new types of yarn. It will also develop and disseminate technical information about nylon and its processing in the textile industry.

A. J. Nisbet, who has been engaged in nylon product development work, was appointed assistant manager of the Technical Service unit.

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### ● AIDED ATOMIC BOMB RESEARCH

Among New York sites where scientists worked to perfect the atomic bomb is the Interchemical Research Laboratories at 432 West 45th Street. Most of the seven-story laboratory building is devoted to studies of chemical coatings and related products, but in one closely-guarded section a group of Interchemical scientists worked secretly to help perfect history's most deadly weapon.

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### ● S-V WAX EMULSION

An easy and economical means by which laundries will be able to make clothing, drapes and other textiles water resistant is provided by a wax emulsion that can be added to the final rinse water, according to scientists of Socony-Vacuum Oil Company, Inc., who developed the fluid.

During the war the quantity of the fluid available for civilians was limited because the armed forces used large amounts for tent duck, uniforms, blankets and other fabrics, to make such articles water and mildew repellent.

Such articles as dresses, slacks, play suits, sports jackets, cloth hats, shorts and fabric shoes are especially suited to its use by laundries, it is pointed out. Its application is obvious in protecting drapes and furniture covers subject to outdoor moisture or the dampness existing on porches and at the seashore.

It is stated that tests conducted by Socony-Vacuum have shown that the wax-treated fabric not only becomes water resistant but at the same time does not spot easily, and, because water does not adhere to the cloth, a garment retains its press longer and is less likely to wrinkle.

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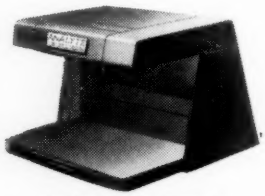
### ● ANALYTE COMPARATOR

The new Analyte North Light Comparator for color matching has been announced by Analyte Instruments, Inc., 1450 Broadway, New York 18, N. Y. The following claims are made for this instrument: color matching is said to be stepped up to higher definitions than ever before obtained in color matching lamps; has both incandescent light and Analyte north light for contrast, said to give extraordinary color separations which reduce color matching errors to a minimum; the Analyte Comparator is said to be the nearest reproduction of north light in existence, according to well-known authorities; the analyte spectrum is said to be completely continuous, consisting of overlapping bands.



*Analyte Comparator*

Dr. Chauncey Starr in ascertaining the quality of Analyte in the Russell Sage Laboratory, Department of Electrical Engineering and Physics, Rensselaer Polytechnic Institute, reported: "This light may be considered the equivalent of north sky light. The spectrum is completely continuous, consisting of overlapping bands. As far as I am aware, no other non-incandescent source gives a spectrum that compares with this one for continuity and lack of peaks."

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### ● ELECTED PRESIDENT, AMERICAN TARIFF LEAGUE

The election of H. Wickliffe Rose as president has been announced by the American Tariff League. Mr. Rose, assistant to the president of the American Viscose Corporation, succeeds Frederick K. Barbour, president, Linen Thread Company, New York, who became chairman of the League's Executive Committee.

Roy C. McKenna, board chairman, Vanadium-Alloys Steel Company, Latrobe, Pa., was elected first vice president of the League. Wheeler McMillen, Editor-in-Chief, "Farm Journal," and a member of the League's Board of Managers, was elected to the Executive Committee. Two new Board members were also added. They are: J. H. Schermerhorn, president, Joseph Dixon Crucible Company, Jersey City, N. J. and D. Joseph O'Connor, vice president, The Acme Shear Company, Bridgeport, Conn.

The new League president, Mr. Rose, is chairman of the Board of Governors of the Philadelphia Textile Institute, a trustee of the Philadelphia Museum of Art, and a member of the Executive Committee of the Textile Research Institute. He graduated from Harvard in 1919, and started his business career with the Packard Motor Car Company in New York. After several years, he entered the textile business and engaged in buying cotton for a group of mills.

In 1924, Mr. Rose joined the American Viscose Corporation as Southern sales manager, and in the following year opened the first rayon sales office in the South at Charlotte, N. C. In 1935, he became Manager of Sales for rayon staple fiber in the New York office when the American Viscose Corporation began to manufacture that product. In 1942, after the business had been developed to a hundred million pounds annual capacity, Mr. Rose was transferred to the corporation's main office at Wilmington, Delaware, where he assists the president in a general capacity.

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### ● E AWARD TO NUODEX

Announcement of the second Army-Navy "E" award to the men and women of Nuodex Products Co., Inc., for their continued efforts in production, was made by Leo Roon, President.

Lt. Col. Wm. R. Stanert, Deputy Director of Procurement, Q.M.C., Jersey City, N. J., made the award at the main plant in Elizabeth, New Jersey on Friday, August 24th.

***Keep ON***
***Buying***
***and***
***HOLDING***
***Bonds!***

# Proceedings of the
# American Association of Textile Chemists and Colorists

SEPTEMBER 24, 1945

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### STUDENT CHAPTERS

**Lowell Textile Institute**
**North Carolina State College**
**Philadelphia Textile Institute**
**New Bedford Textile School**

Members should notify the **Secretary** immediately of all address changes

# Committee on WATER RESISTANCE OF FABRICS

*Progress Report for 1945*

THE following report represents a brief summary of the last two meetings of the committee held on January 11 and June 21, 1945, respectively. The official actions and discussions are given below on the basis of classification according to test.

### HYDROSTATIC PRESSURE TEST

At the meeting of January 11, 1945, the merits of both the A.A.T.C.C. Tester and the Suter Tester were discussed. It was pointed out that the Suter Tester has been found to be more suitable for testing garments and is also adapted to measuring the rate of leakage at a definite head, whereas this is not possible with the A.A.T.C.C. instrument. The principal objection to the Suter instrument was the lack of temperature control as ordinarily used. When either instrument is used to measure the head or pressure at which a given fabric starts to leak, which is the primary object of such a test, the results between the two instruments can now be correlated when run at the same temperature using the data reported by Mr. Ryberg of the Lowell Textile Institute at the meeting of October 12, 1944. In view of this situation, the committee voted unanimously to adopt the A.A.T.C.C. Tester as the *Official Standard* instrument for the Hydrostatic Pressure Test with the Suter Tester as an alternate or optional method.

### IMMERSION TEST

At the meeting of June 21, it was pointed out that new specifications for the blotting paper used in this test were found to be necessary. These specifications are based on the standard tests of the Technical Association of the Pulp and Paper Industry. A discussion of the re-use of the blotters after drying and conditioning resulted in a consensus of opinion that a fresh blotter should be used for each test until conclusive work has been completed in reference to re-use. The Immersion Test is to be continued as a *Tentative Standard* Test.

### IMPACT PENETRATION TEST

At the meeting of January 11, this test originally described by Mr. Slowinske in the February 15, 1943 issue of the American Dyestuff Reporter was discussed in some detail. It was felt by the committee that this type of test was more closely related to rain resistance than some of the other methods now in use. Study of the method thus far indicates that it is a relatively mild test but that it gives comparative results in a relatively short time. The most useful aspect of this test appears to be that by its means, the poorer types of fabric for use in rain resistant garments may be quickly eliminated. By a unanimous vote of the committee, the Impact Penetration Test was adopted as a *Tentative Standard* of the A.A.T.C.C.

At the meeting of June 21, this method was further discussed, particularly in respect to the backing of the fabric during the test. The opinion was expressed that the use of a resilient backing such as sponge rubber instead of a stainless steel plate might give the test a more practical relationship to actual rain exposure.

For the present, the test remains as a *Tentative Standard*.

### DROP PENETRATION TEST

In both meetings of January 11 and June 21, methods of this type were discussed in detail, particularly the Harris-Sookne Drop Penetration Tester and the test which has been developed by Mr. Ryberg at the Lowell Textile Institute. Correlation of the Harris-Sookne Tester to actual exposure to rain has been studied by the Philadelphia Quartermaster Depot but the results are not as yet complete.

As to the method now being used at the Lowell Textile Institute, a considerable amount of data has been accumulated and further studies are being made. In general, this test is more severe than the Impact Penetration Test and involves longer test periods. The main variable in the study thus far has been the height of the spray and the data which has been accumulated indicates that a 6 foot head is quite satisfactory for highly water repellent fabrics. For fabrics of a lower degree of water repellency, it has been found desirable to use a lower head in order to evaluate them satisfactorily.

### RAIN TESTERS

At both meetings, these types of instruments were discussed and it was recognized that in all probability such testers would give the best correlation to actual exposure to rainfall. However, such testers are very expensive and require special installations so that they cannot be commonly used by most laboratories.

### DYNAMIC ABSORPTION TEST

This test, developed by the Quartermaster Corps of the U. S. Army and described in detail in Tentative Specification P.Q.D. No. 447A on pages 7 and 8 was discussed at the meeting of January 11 and plans were made to study this method with a view to evaluating it for possible adoption. At the meeting of June 21, there was no progress report on the status of this method.

### MISCELLANEOUS BUSINESS

At the meeting of June 21, there was a discussion of the question of the eligibility of members of this committee who are no longer active. As a result of this discussion, it was voted unanimously by the committee that members of this committee who do not attend or take any active part in its activities during a period of two years shall be dropped from the committee at the end of this period.

ALTON A. COOK, *Secretary*
*A.A.T.C.C. Committee on Water Resistance of Fabrics*

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## MEETING DATES, PHILADELPHIA SECTION

THE following are the meeting dates for the Philadelphia Section for the 1945-46 season: October 19, 1945, November 30, 1945, January 18, 1946, March 1, 1946, April 12, 1946, May 24, 1946.

NOTICE TO SECRETARIES OF LOCAL SECTIONS:

Please advise the National Secretary or the American Dyestuff Reporter of your meeting dates for the 1945-1946 season as soon as available.

## CALENDAR OF COMING EVENTS

Meetings, Council and Research Committee, Hotel Commodore, New York City, October 5, 1945. Chairmen of Sub-Committees who wish to hold meetings on October 4th at the Hotel Commodore should notify Dr. Louis A. Olney.

Meeting, Piedmont Section, Hotel Charlotte, Charlotte, N. C., October 13, 1945. Election of officers will be held.

Meeting, New York Section, Downtown Athletic Club, New York City, October 19, 1945.

Meeting, Philadelphia Section, October 19, 1945.

Meeting, Rhode Island Section, October 26, 1945.